



# Course Outline

MATS1192

Design and Application of Materials in Science  
and Engineering

Materials Science and Engineering

Science

T3, 2022

## 1. Staff

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Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Dr Caitlin Healy	<a href="mailto:caitlin.healy@unsw.edu.au">caitlin.healy@unsw.edu.au</a>	Room 401, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9065 0450
Lecturer	Professor Nagarajan Valanoor	<a href="mailto:nagarajan@unsw.edu.au">nagarajan@unsw.edu.au</a>	Room 247, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 4263
Lecturer	Associate Professor Rakesh Joshi	<a href="mailto:r.joshi@unsw.edu.au">r.joshi@unsw.edu.au</a>	Room 448, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9065 9731

## 2. Course information

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Units of credit: 6

Pre-requisite(s): None

Timetabling website: <https://timetable.unsw.edu.au/2022/MATS1192.html#S3S>

Teaching times and locations:

	Lecture	Lecture	Seminar	Seminar
<b>Day</b>	Monday	Tuesday	Thursday	Friday
<b>Location</b>	Science & Engineering G05	Law Theatre G23	Old Main Building 230	Tyree Energy Technology
<b>Time</b>	11:00-13:00	10:00-12:00	9:00-12:00	09:00-12:00
<b>Weeks</b>	1-3, 5,7-10	1-10	10	2, 10

\*For laboratory classes and site visits, see the course Moodle site.

### 2.1 Course summary

The design of materials for applications in industry and society including, for example, metallurgical, electronic, medical, packaging and transport. Microstructure and structure-property relationships of the main types of engineering materials (metals, ceramics, polymers and composites); micromechanisms of elastic and plastic deformation; fracture mechanisms for ductile and brittle materials, phase equilibria of alloys; microstructural control and application to commercial engineering materials. Information retrieval. Communication skills. Plant visits. Introductory materials laboratories. Application of fundamental learning to problem solving.

## 2.2 Course aims

To learn fundamental materials property-structure relationships pertinent to the design and application of components and to place materials science and engineering in context within the discipline and society.

## 2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Describe basic property-structure relationships in materials
2. Understand context of materials science and engineering in design and applications within society
3. Communicate above using a range of media

## 2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Describe...	1.1, 1.3, 1.4 & 1.5	1, 2, 4 & 5
CLO 2	Understand...	1.5, 1.6, 3.1 & 3.5	1, 2, 3, 4 & 5
CLO 3	Communicate...	3.2 & 3.6	2, 3 & 4

## 3. Strategies and approaches to learning

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### 3.1 Learning and teaching activities

(based on UNSW Learning Guidelines)

- *Students are actively engaged in the learning process.*

It is expected that, in addition to attending classes, labs and site visits, students will read, write, discuss, and engage in analysing the course content.

- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

- *Learning is more effective when students' prior experience and knowledge are recognised and built on.*

This course is built on students' prior learning in mathematics, physics and chemistry. Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are

intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

- *Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts*

The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.

### **3.2 Expectations of students**

- Students must attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances
- Students must read through lecture notes and lab sheets prior to class
- During class, students are expected to engage actively in class discussions
- Students should work through lecture, tutorial and textbook questions
- Students should read through the relevant chapters of the prescribed textbook.
- Students should complete all assessment tasks and submit them on time.
- Students are expected to participate in online discussions through the Moodle page
- Students are expected to attend all off-campus visits

## 4. Course schedule and structure

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This course consists of 47 hours of class contact hours and 20 online contact hours over the term. You are expected to take an additional 83 hours of non-class contact hours to complete assessments, readings and exam preparation spread over the term.

Week	Topics	Activity
1	Introduction Atomic bonding Atomic packing	Online tutorial
2	Defects Diffusion Atomic structure of metals WHS Welcome to the School of Materials Science and Engineering	Online tutorial
3	Phase diagrams Elastic deformation Laboratory: Energy materials	Online tutorial Lab
4	Public Holiday Plastic deformation Dislocations	Online tutorial
5	Introduction to fast fracture Ethics in engineering Strengthening Laboratory: Tensile testing	Online tutorial Lab
6	Site visit	Online tutorial Site visit
7	Fast fracture Steels Laboratory: Steel Microstructures	Online tutorial Lab
8	Non-ferrous alloys Polymers	Online tutorial
9	Ceramics Site visit	Online tutorial Site visit
10	Composites and Nanomaterials Revision Student Conference	Student Conference

## 5. Assessment

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### 5.1 Assessment tasks

Assessments	Description	Weight	Due date
<b>Online quizzes:</b>	<p>There will be four online quizzes spread throughout the semester. These quizzes will help you to assess your progress in the course and identify topics that require further study:</p> <ul style="list-style-type: none"> <li>a) Phase diagrams and phase transformations</li> <li>b) Mechanical behaviour</li> <li>c) Ferrous and non-ferrous alloys</li> <li>d) Polymers, ceramics and composites</li> </ul> <p>In addition, there will be an online quiz on atomic bonding that must be completed in Week 1. This does not form part of the assessment but will introduce you to the online learning environment used throughout the course.</p>	15%	See Moodle for dates
<b>Laboratory reports:</b>	<p>You will attend three laboratory demonstrations, which will demonstrate some of the concepts covered in the classes and will help develop your understanding of these concepts. You will submit a short report on each laboratory activity, one week after the lab (each report is worth 3% of your mark for the course).</p>	9%	Various dates see Moodle for details
<b>Professional experience portfolio:</b>	<p><b>Industry experience:</b> You will attend two industry site visits, which will demonstrate industry applications of materials science and engineering, as well as career opportunities for materials scientists and engineers. You will submit a short report at the conclusion of each site visit (each report is worth 2% of your mark for the course).</p> <p><b>Academic experience:</b> Working in groups of 4-5 students, you will interview a member of academic staff in the School of Materials Science and Engineering to learn about their research work. You will submit a written report based on what you learned during the interview.</p> <p><b>Conference experience:</b> Students will select a specific application of a material of their choice to research. They will be asked to prepare a written report on their chosen topic and give a 5-minute presentation.</p> <p><b>First year camp:</b> Attendance at the first-year engineering camp is designed to teach students networking skills and build professional relationships that will be valuable; students not able to attend first year camp are required to submit a one-page report, details below.</p>	31%	Ongoing dates see Moodle for details
<b>Final exam:</b>	<p>There will be a 2-hour exam in the final exam period (a mixture of question types), on all the topics covered in the course.</p>	45%	Final exam period

## Further information

UNSW grading system: <https://student.unsw.edu.au/grades>

UNSW assessment policy: <https://student.unsw.edu.au/assessment>

## 5.2 Assessment criteria and standards

### Online Tutorials and Quizzes

Tutorials will become available on the course Moodle site in the same week as the relevant material is taught in the lectures. There will be assessed quizzes for the topics of atomic bonding, phase diagrams, tensile properties and fracture, ferrous and non-ferrous alloys, and polymers, ceramics and composites. Students will have approximately 2 days to complete each quiz, which must be done in 1.5 hours. Students are expected to inform themselves of the quiz deadlines by regularly checking the Moodle site; quiz dates will also be announced in the lectures.

### Laboratory Reports

There will be three lab demonstrations. Students will work in groups with a demonstrator.

- Energy materials: Students will investigate the materials selection criteria that go into designing everyday batteries. Using materials property charts and a range of materials students will create the greatest power output. Students will also use a deconstructed AA battery to determine what additional materials properties need to be considered other than power output.
- Tensile Testing: Standard tensile testing will be undertaken on steel and aluminium alloys to determine properties such as elastic modulus, yield strength and ductility. The stress-strain curves of these different materials will be compared, and their fracture surfaces will be studied to link deformation mechanisms to failure properties.
- Steel microstructures: The microstructures of steel with different carbon content and to which different heat treatments have been applied will be examined. The differences in the microstructures and mechanical properties will be discussed.

A simple written laboratory report is required for each demonstration and should be submitted one week after the lab on the course Moodle site.

### Industry Site Visits

Students will visit ANSTO and Brickworks. The purpose of these site visits is to learn about practical applications of materials science and engineering, and to discover potential future career paths.

For the visit to ANSTO, students must submit their personal information in advance (the exact date for submission will be announced in due course). Proof of identify (driving licence for local students, passport for international students) must be provided on the day of visit. Fully enclosed shoes must be worn.

For the visit to Brickworks, long cotton trousers and fully enclosed shoes must be worn.

Attendance at industrial site visits is compulsory. A short report will be submitted at the end of each visit, which will form part of the course assessment. Students unable to attend on health grounds or due to class clashes should make a request for special consideration. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer.

### **Interview with an Academic**

Students will be divided into groups of 4-5. Each group will be asked to interview a member of academic staff (Teaching or Research only) in the School of Materials Science and Engineering. Students must arrange the interview time and location with their assigned academic; interviews should take place in Weeks 5-7. The group will complete an interview report, which includes the following areas:

- Background of the research area(s) of the academic staff they interviewed
- Why the academic thinks this research field is important/interesting
- Contributions of the academic staff in their research area
- Future trend of the research field

The report should be 700-900 words in length. Do not just copy the biodata or publications of the academic staff from their website (you may, however, put these into an appendix). The report should be submitted on Moodle by 5pm on Friday, Week 8.

### **Conference Presentation and Report**

Students will select a specific application of a material of their choice to research. They will be asked to prepare a written report on their chosen topic and give a 5-minute presentation. Full details of the assignment requirements and assessment will be made available on the Moodle site at the start of the course.

- *Report (8 marks)*

A written report of approximately 1000 words on the student's topic should be prepared. A reference list using a recognised citation style must be included; the reference list should not be included in the word count (how to cite correctly will be covered in the Ethics class in Week 4). Students should submit the final report in MS Word or pdf format on the course Moodle site by 9am on Friday, Week 9.

- *Presentation (8 marks)*

The presentation should be prepared in PowerPoint. 5 minutes will be allocated to each student. The final PowerPoint file for the presentation should be submitted on the course Moodle site by 9am on Monday, Week 10.

- *Peer assessment (2 marks)*

Presentations will be given in groups of ~25 students. Each student will provide feedback on the presentations given by 5 other students in their group. Feedback will be given through the course Moodle site. Providing this feedback will help develop the critical thinking and communication skills of the assessor and will also provide useful feedback to the presenting student to help them improve their presentation skills.

### **First Year Camp Replacement Report**

Students unable to attend the first-year camp are requirement to submit a one-page report covering (350-450 words in length):

- 1) Explain what is meant by materials science and engineering, in a way that your parents/ grandparents/ brother/ sister/ cousin could understand
- 2) Why did you choose to study materials science and engineering?
- 3) What are you most interested to learn about materials science and engineering? What question would you most like to have answered?
- 4) Why is making friends and building a social network amongst other materials science and engineering students at UNSW important?

### **Final Exam**

A 2-hour final exam will be held at the end of the semester, covering all material taught in the course. The exam will consist of a mixture of different types of questions.



**Note:** Students who fail to achieve a score of at least 40% for the final exam but achieve a final mark >50% for the course, may still be awarded a UF (Unsatisfactory Fail) for the course.

Please refer to the UNSW guide to grades: <https://student.unsw.edu.au/grades>

### 5.3 Submission of assessment tasks

- UNSW operates under a Fit to Sit/ Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. Information on this process can be found here: <https://student.unsw.edu.au/special-consideration>. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.
- Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.
- Assignments/lab reports submitted after the due date for submission will receive a 5% of maximum grade penalty for every day late, or part thereof up to a maximum of 5 days, after which the task will not be accepted.
- Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit: <https://student.unsw.edu.au/disability>. Early notification is essential to enable any necessary adjustments to be made.

### 5.4. Feedback on assessment

Online quizzes: Students will receive feedback as an ongoing mark for the quizzes

Online tutorials: Students will receive instant feedback on whether they got each question correct or not; in the case where the students answer was wrong, they will be given a hint to attempt the question again or provided with an explanation of the correct answer.

Assignments: Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, and any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Lab reports: Students will receive their mark and individualised feedback on the areas they excelled at and which areas of the reports that were not answered correctly. Feedback will be provided through Moodle, two weeks after submission.

Final exam: Students will receive their final mark.

## 6. Academic integrity, referencing and plagiarism

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**Referencing** is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism. Number referencing styles are preferred.

Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>

**Academic integrity** is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage.<sup>1</sup> At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

- The *Current Students* site <https://student.unsw.edu.au/plagiarism>, and
- The *ELISE* training site <http://subjectguides.library.unsw.edu.au/elise/presenting>

The *Conduct and Integrity Unit* provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>.

## 7. Readings and resources

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Some recommended reference material will be provided during class and electronic copies uploaded to Moodle. Textbooks available from the UNSW library which provide good information are listed below.

### Textbooks

- Engineering Materials 1 and 2, M.F. Ashby and D.R.H. Jones, Butterworth Heinemann, 4<sup>th</sup> Edition.
- Fundamentals of Materials Science and Engineering: An Introduction, W.D. Callister, D.G. Rethwisch, Wiley, Australia & New Zealand Edition

### Recommended Reference Material

- The Science and Engineering of Materials, D.R. Askerland, PWS Publishing Co.
- Fundamentals of Materials Science and Engineering: An Integrated Approach, W.D. Callister, D.G. Rethwisch, Wiley, 4<sup>th</sup> Edition
- Introduction to Materials Science for Engineers, J.F. Shackelford, Maxwell Macmillan.
- Principles of Materials Science and Engineering, W.F. Smith, McGraw-Hill. Engineering Materials and Their Applications, R.A. Flinn and P.K. Trojan, Haughton.
- Materials for Engineering, L.H. Van Vlack, Addison-Wesley.
- Materials for the Engineering Technicians, R.A. Higgins, Edward Arnold.
- Materials Science – A Multimedia Approach (electronic resource), John Russ, PWS Publishing Co.
- R.E. Smallman and R. Bishop, Metals and Materials, 1996

## 8. Administrative matters

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School Office: Room 137, Building E10 School of Materials Science and Engineering

School Website: <http://www.materials.unsw.edu.au/>

Faculty Office: Robert Webster Building, Room 128

Faculty Website: <http://www.science.unsw.edu.au/>

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<sup>1</sup> International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

## 9. Additional support for students

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- The Current Students Gateway: <https://student.unsw.edu.au/>
- Academic Skills and Support: <https://student.unsw.edu.au/academic-skills>
- Student Wellbeing, Health and Safety: <https://student.unsw.edu.au/wellbeing>
- Disability Support Services: <https://student.unsw.edu.au/disability-services>
- UNSW IT Service Centre: <https://www.it.unsw.edu.au/students/index.html>
- Assessment Implementation Procedure:  
<https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf>